

**WHAT IS CLAIMED IS:**

1. A wireless relay based network (600, 800, 900, 1000 and 1100) comprising:

5 a first node (602, 802, 902, 1002 and 1102);

at least one relay station (606, 806a, 806b, 906a, 906b, 1006 and 1106); and

a second node (604, 804, 904, 1004 and 1104), characterized by said first node communicates with said  
10 second node via said at least one relay station, wherein each relay station is capable of:

receiving (702) a digital communication (607a, 807a, 807a', 907a, 907a', 1007a and 1007a') from said first node;

15 computing (704) a plurality of reliability values for a plurality of symbols in the received digital communication; and

transmitting (706) a digital communication (607b, 807b, 807b', 907b, 907b', 1007b and 1007b') that has  
20 the computed reliability values embedded therein to said second node.

2. The wireless relay based network of Claim 1, wherein each relay station performs the computing step  
25 using a maximum a posteriori (MAP) filter (612a) that computes reliability values for code symbols based on a code structure of the received digital communication.

3. The wireless relay based network of Claim 2,  
wherein each MAP filter also filters the received digital  
communication and redistributes noise to unreliable parts  
5 in the transmitted digital communication.

4. The wireless relay based network of Claim 1,  
wherein each relay station performs the computing step  
using a soft output channel decoder (612b) that computes  
10 reliability values for information symbols based on a code  
structure of the received digital communication.

5. The wireless relay based network of Claim 4,  
wherein said soft output channel decoder employs:  
15 a maximum a posteriori (MAP) algorithm;  
a soft output Viterbi algorithm (SOVA);  
a Log-MAP algorithm; or  
a Max-LOG-MAP algorithm.

20 6. The wireless relay based network of Claim 1,  
wherein the computed reliability values are embedded in the  
transmitted digital communication such that high  
reliability symbols are transmitted with higher power and  
low reliability symbols are transmitted with lower power to  
25 said second node.

7. The wireless relay based network of Claim 1,  
wherein the computed reliability values are embedded in the  
transmitted digital communication in a manner where the  
reliability symbols are used to modulate an amplitude of  
5 the digital communication transmitted to said second node.

8. The wireless relay based network of Claim 1,  
wherein the computed reliability values are embedded in the  
transmitted digital communication in a manner where the  
10 reliability symbols are used to modulate a phase of the  
digital communication transmitted to said second node.

9. The wireless relay based network of Claim 1,  
wherein the computed reliability values are embedded in the  
15 transmitted digital communication in a manner where the  
reliability symbols are used to vary a bandwidth of the  
digital communication transmitted to said second node.

10. The wireless relay based network of Claim 1,  
20 wherein the computed reliability values are embedded in the  
transmitted digital communication in a manner where the  
reliability symbols are used to vary a signal time  
occupation of the digital communication transmitted to said  
second node.

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11. The wireless relay based network of Claim 1,  
wherein the computed reliability values are embedded in the  
transmitted digital communication in a manner where the  
reliability symbols are used to vary a signal constellation  
5 size of the digital communication transmitted to said  
second node.

12. The wireless relay based network of Claim 1,  
wherein said first node is:  
10 a base station;  
a mobile station; or  
a relay station.

13. The wireless relay based network of Claim 1,  
15 wherein said second node is:  
a base station;  
a mobile station; or  
a relay station.

20 14. The wireless relay based network of Claim 1,  
wherein each relay station is:  
a base station;  
a mobile station; or  
a stand alone relay station.

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15. The wireless relay based network of Claim 1,  
wherein said received digital communication is:

an uplink received digital communication;

a downlink received digital communication;

5 a base station peer-to-peer received digital  
communication; or

a mobile station peer-to-peer received digital  
communication.

10 16. The wireless relay based network of Claim 1,  
wherein said transmitted digital communication is:

an uplink transmitted digital communication;

a downlink transmitted digital communication;

15 a base station peer-to-peer transmitted digital  
communication; or

a mobile station peer-to-peer transmitted digital  
communication.

20 17. The wireless relay based network of Claim 1,  
wherein when multiple relay stations each transmit the  
digital communication then said second node combines the  
transmitted digital communications.

25 18. The wireless relay based network of Claim 1,  
wherein when one relay station transmits multiple digital  
communications at different times then said second node  
combines the transmitted digital communications.

19. The wireless relay based network of Claim 1, wherein when one relay station knows a channel response of a link between that relay station and said second node then that relay station is able to construct a transmitted  
5 digital communication which is coherently combined at said second node with a similar transmitted digital communication received from another relay station.

20. A relay station (606, 806a, 806b, 906a, 906b,  
10 1006 and 1106) capable of enabling communications between a first node (602, 802, 902, 1002 and 1102) and a second node (604, 804, 904, 1004 and 1104) by performing the following steps characterized by:

receiving (702) a coded/modulated digital  
15 communication (607a, 807a, 807a', 907a, 907a', 1007a and 1007a') from said first node;

computing (704) a plurality of reliability values for a plurality of symbols in the received coded/modulated digital communication; and

20 transmitting (706) a coded/modulated digital communication (607b, 807b, 807b', 907b, 907b', 1007b and 1007b') that has the computed reliability values embedded therein to said second node.

21. The relay station of Claim 20, further comprising  
a maximum a posteriori (MAP) filter (612a) that computes  
reliability values for code symbols based on a code  
structure of the received coded/modulated digital  
5 communication.

22. The relay station of Claim 20, further comprising  
a soft output channel decoder (612b) that computes  
reliability values for information symbols based on a code  
10 structure of the received coded/modulated digital  
communication.

23. The relay station of Claim 20, wherein the  
computed reliability values are explicitly embedded in the  
15 coded/modulated digital communication transmitted to said  
second node.

24. The relay station of Claim 20, wherein the  
computed reliability values are implicitly embedded in the  
20 coded/modulated digital communication transmitted to said  
second node.

25. The relay station of Claim 20, wherein said relay  
station is used in a wireless multi-hop network.

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26. The relay station of Claim 20, wherein a link between said relay station and said first node has a smaller bandwidth than a link between said relay station and said second node.

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27. The relay station of Claim 20, wherein each relay station is:

a base station;

a mobile station; or

10 a stand alone relay station.

28. A method (700) for enabling a relay station (606, 806a, 806b, 906a, 906b, 1006 and 1106) to provide reliable digital communications between a first node (602, 802, 902, 15 1002 and 1102) and a second node (604, 804, 904, 1004 and 1104), said method characterized by the following steps:

receiving (702), at said relay station, a digital communication (607a, 807a, 807a', 907a, 907a', 1007a and 1007a') from said first node;

20 computing (704), at said relay station, a plurality of reliability values for a plurality of symbols in the received digital communication; and

transmitting (706), at said relay station, a digital communication (607b, 807b, 807b', 907b, 907b', 1007b and 25 1007b') that has the computed reliability values embedded therein to said second node.



29. The method of Claim 28, wherein said computing  
step if performed a maximum a posteriori (MAP) filter  
(612a) that computes reliability values for code symbols  
based on a code structure of the received digital  
5 communication.

30. The method of Claim 28, wherein said computing  
step if performed a soft output channel decoder (612b) that  
computes reliability values for information symbols based  
10 on a code structure of the received digital communication.

31. The method of Claim 28, wherein the computed  
reliability values are explicitly embedded in the digital  
communication transmitted to said second node.

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32. The method of Claim 28, wherein the computed  
reliability values are implicitly embedded in the digital  
communication transmitted to said second node.

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